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SENSORY TRANSDUCTION

How TRPs discriminate between different stimuli

Transient receptor potential (TRP) channels transduce a wide variety of stimuli and are used by many different organisms to monitor changes in their environment. How these channels are able to discriminate between different stimuli is unknown, but a recent study in *Drosophila melanogaster* indicates that the existence of TRP channel isoforms might be key.

In *D. melanogaster*, the TRPA1 channel responds to innocuous warmth and noxious chemical stimuli. The TRPA1 channels on sensory receptor cells of the fly mouthparts act to prevent ingestion of toxic electrophiles such as N-methylmaleimide (NMM), and TRPA1 channels expressed in the brain mediate the thermal preference of flies to a temperature range that is optimal for fly survival. Kang *et al.* found that *D. melanogaster* neurons express two TRPA1 isoforms that are identical except for their amino termini. One isoform, termed TRPA1(A) was preferentially expressed in the fly proboscis, and the other isoform, TRPA1(B), was expressed in the brain. Although both isoforms responded to NMM, TRPA1(A) was much less thermosensitive than TRPA1(B).

To investigate the properties of these isoforms and their roles in stimulus detection, the authors used each of the TRPA1 isoforms to rescue the *TrpA1* mutant. They found that both TRPA1(A) and TRPA1(B) could restore electrophile sensitivity but only TRPA1(B) conferred thermosensitivity to the chemosensors. Therefore, the TRPA1(A) isoform that is typically expressed on chemosensors in the proboscis is unable to confer warmth sensitivity. Interestingly, when the TRPA1(B) isoform was expressed in the chemosensors, innocuous warming elicited a nocifensive response, indicating that misexpression of this thermosensitive isoform disrupts appropriate behavioural responses to innocuous stimuli.

Using mutational analysis, the authors located specific conserved residues in the N terminus, which when mutated, radically increased the temperature responsiveness of TRPA1(A) channels to innocuous warmth. This suggests that TRPA1(A) channels have the necessary elements for thermosensation but that its unique N terminus inhibits these elements from exerting their full effect.

These findings suggest that through selective expression of different TRPA1 isoforms in different parts of the nervous system, flies are able to elicit different behavioural responses to thermal or chemical stimuli.

Furthermore, Kang *et al.* also found that the TRPA1(A) and TRPA1(B) isoforms are expressed in the malaria mosquito. The authors hypothesize that this might be the mechanism by which mosquitos discriminate between attractive host-generated warmth and noxious chemorepellants. If these two behaviours could be targeted independently, it might lead to improved strategies for tackling mosquito behaviour.

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ORIGINAL RESEARCH PAPER Kang, K. *et al.* Modulation of TRPA1 thermal sensitivity enables sensory discrimination in *Drosophila*. *Nature* 4 Dec 2011 (doi:10.1038/nature10715)

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